

ment, had been reduced to about two-thirds of its former size, with an increase in the jaundice and in hardness of the consistency. Whether we shall succeed in arriving at a suitable stage is doubtful, but should the spleen be reduced to a manageable size this operation will be urged upon the patient. A prominent clinician recently stated at a public gathering that while he himself would not submit to splenectomy for pernicious anemia, he would have this operation done for chronic congenital family icterus. The after-effects have been striking in some cases, the jaundice entirely disappearing. In the acquired family jaundice the fragility of the cells has been corrected and their normal resistance to hemolysis has been restored; but in the congenital family icterus the cells never regain their normal resistance. The reticulated red cells, of which there is normally 1 per cent. in the blood, looked upon by some observers as indicative of destruction, are probably an indication of regeneration, rising from 5 to 20 per cent. in this disease. The coagulation time and the grade of hemolysis unfortunately were not tried out in this case. Aside from the histological study of the removed spleen the diagnosis could hardly be questioned.

THE PRINCIPLE OF BLOOD GROUPING APPLIED TO SKIN GRAFTING.

BY HAROLD K. SHAWAN, M.D., CAPTAIN, M. C., U. S. A.,
LAKESIDE, U. S. A. GENERAL HOSPITAL, B. E. F., DETROIT.

GRAFTS may be classified as *autografts*, where the skin is transplanted from the same individual; *isografts*, where the skin is obtained from another person; and *zoögrafts*, where the graft is taken from one of the lower animals. All observers agree that the autograft is the most satisfactory, that a permanent take is least likely or impossible to obtain with zoögrafts, while such uncertain results are obtained with isografts that many surgeons have been led to abandon their use.

With the use of isografts, whether partial or total thicknesses of the skin, a peculiar phenomena has frequently been observed. In the course of the second to the fourth week a certain percentage of these apparently healthy primary takes begin a slight desquamation of the epidermis, then they show signs of resorption by becoming smaller, paler and thinner, and shortly are either reduced to a mere bluish pellicle or have completely disappeared. The grafts apparently fade or melt away little by little. Having had similar experiences, and having seen the uniformly successful results obtained in blood transfusion with matched blood, it occurred to me that the

permanent success of isodermic grafts might be dependent on the same underlying principles.

The present status of blood grouping may be briefly stated as follows: Based on the interaction of serum or plasma and red blood cells, each individual is placed in one of four groups. This classification, as stated by Moss, is as follows:¹

- Group I. Serum agglutinates corpuscles of no person.
Corpuscles are agglutinated by serum of Groups II,
III and IV.
- Group II. Serum agglutinates corpuscles of Groups I and III.
Corpuscles are agglutinated by serum of Groups III
and IV.
- Group III. Serum agglutinates corpuscles of Groups I and II.
Corpuscles are agglutinated by serum of Groups II
and IV.
- Group IV. Serum agglutinates corpuscles of Groups I, II and III.
Corpuscles are agglutinated by serum of no person.

Groups I and III are rare groups; Groups II and IV are common. The relative incidence of the four groups, as found by Karsner² in 1000 groupings, was: Group I, 3.1 per cent.; Group II, 42.4 per cent.; Group III, 8.3 per cent.; Group IV, 46.2 per cent.

In the transfusion of blood one remembers that the important point is the effect of the patient's plasma on the cells to be introduced. What then can be expected in the transplantation of skin? If one substitutes the term "skin graft" for the "cells" in the above table, like effects may be looked for. It can be readily seen then that if a skin donor is used in the same blood groups as the recipient to be grafted, or if autodermic grafts are used, no resorption of the graft should occur. Going still further with the simile, and adopting the suggestion advanced by Lee³ and upheld by general usage, that as Group IV blood donors may be used for patients belonging to any of the four groups, because in actual transfusion agglutination does not occur in either direction, so in skin grafting permanent takes may be expected from this "universal door" class. Such was our experience in every instance. That is, while initial takes were recorded with skin from donors of all four groups, on recipients of all four groups, only autodermic grafts and matched isografts, including Group IV donors, remained permanent takes and continued to grow and expand.

One donor from each of the four blood groups was used for every grafting. Usually all four groups were represented among recipients, and were used as donors of grafts as well. In each

¹ Moss, W. L.: Simplified Method for Determining the Iso-agglutin Group in the Selection of Donors for Blood-transfusion, *Jour. Am. Med. Assn.*, 1917, lxviii, 1905.

² Transfusion with Tested Bloods, *Jour. Am. Med. Assn.*, 1918, lxx, 769.

³ A Simple and Rapid Method for the Selection of Donors, *British Med. Jour.*, 1917, ii, 684.

instance the bloods of both donors and recipients used in the skin-grafting experiments were tested according to the simple and rapid method recommended by Lee, using serums of individuals of Group II and III originally furnished this Base Hospital by Major Lee. In every case Group IV serum was used to check up the results.

For the sake of comparison, Thiersch grafts were used in the first half of the cases and Wolfe grafts in the latter half, with no difference noted either in the primary or the permanent "takes." The long strips of skin thus secured were cut into sections, as recommended by Douglas, Colebrook and Fleming,⁴ and either grafted on at once or wrapped in gauze moistened with warm saline until ready for use. An hour was the greatest delay in the latter instance.

As the problem at hand concerned itself entirely with the fate of skin grafts from donors of the four groups, no effort was made to completely cover the exposed areas. Specimen grafts from the same donor or donors of the same blood groups were placed in close proximity to each other, and always one or more of them were near to the margin of the patient's own ingrowing new skin. Careful tracings and notes were kept of the position and progress. We regarded as *primary takes* only those that attached themselves to the surface by epithelialization. *Primary failures* were those that did not attach themselves and no epithelial growth remained behind.

In the further progress the primary takes pursued one of two well-defined courses: the first, representing biological compatibility, continued to grow and obviously became a permanent part of the anatomy; the second, representing a biological incompatibility, after a brief period of promise became pale, edematous and gradually faded out, sometimes being cast off as a scale. This might occur any time up to a month or more.

The foregoing is based on observations of 26 different patients, 17 of which are available as evidence. These were successfully grafted with sections of skin from each of the four groups and with autografts. Of these 17 cases, 2 were members of Group I, 8 were in Group II, 2 in Group III, and 5 in Group IV.

GROUP I. Case 1. Amputation stump. Preceding grafting, the stump was ionized daily with 1 per cent. sodium chloride and 1 per cent. zinc sulphate by Captain Baker-Young, R. A. M. C. The grafts of all the groups and the autograft showed initial takes and all continued to increase in size and to be healthy in appearance when the patient was evacuated twenty-three days later. (See Group I, Case 1.)

Case 2. Tangential shell wound in the region of the left knee. On the twenty-third day after being wounded the granulating sur-

⁴ On Skin-grafting: A Plea for its More Extensive Application, *Lancet*, London, 1917, exciii, 5.

face was covered with a section graft from each group and one autograft. Seven days later all of the original grafts except that of Group III, which was accidentally removed with the first dressing, were still on. Primary takes of all the remaining groups were present on the eighteenth day. On the twenty-eighth day all grafts had continued to grow as permanent takes and were connecting up with one another and with the patient's own marginal skin growth.

GROUP II. Case 1. Amputation stump. Thiersch skin grafts from donors of each of the four groups and from the recipient himself were applied to the stump surface on January 27, 1918, and again two weeks later. Following neither operation did a Group I, III or autograft take, while strong firm skin was obtained with another Group II and a Group IV in the first and with a different Group IV in the second instance, all of which had continued to grow and increase in size up to the time of evacuation, twelve days later.

Case 2. Amputation stump. Autografts and grafts from donors of each of the four groups were grafted on the stump surface and all took. Between the eighteenth and twenty-third day the Group I and III graft takes grew rapidly smaller and fainter and finally disappeared. Takes from two different Group IV donors and one from the recipient were firmly established and growing when the patient was evacuated twenty-five days later.

Case 3. Amputation stump. One isograft from each of the four groups and one autograft were put on and all had established takes thirteen days later. During the four weeks preceding evacuation the Group I and III grafts diminished to almost pin-head size while the Group II and IV and autograft had more than doubled in size and were firm and healthy. (See Group II, Case 3.)

Case 4. Amputation stump. Surface grafted with several sections of skin from each of the groups and from himself. Takes from all groups were present two weeks later. By the eighteenth day, however, the Group III were faded out. The Group I take gradually decreased in size during the first three weeks, then remained stationary in size for two weeks more, while the recipient's own proliferating epithelium surrounded it and during the sixth week was cast off as a dry scale, leaving takes from two different Group II donors; two different Group IV donors and an autograft growing.

Case 5. Amputation stump. Autografts and grafts from all the groups made primary takes. Group III takes from two different donors became steadily smaller and faded out after three weeks. During the fourth week the Group I take, which had decreased in size, became film-like and disappeared. When evacuated on the thirtieth day only members of Groups II and IV were on. These had steadily increased in size and in one large area had joined up with one another and with the recipient's own surrounding ingrowing skin.

Case 6. Amputation stump of left thigh was grafted with his own and with skins from donors of the four groups. Only autografts took.

Case 7. Amputation stump. Autografts and section of skin from all four groups put on stump a week later. Only autografts became established.

Case 8. Gutter wound of right thigh was grafted with two Group III and one Group II graft five weeks later. Only the Group II graft was a permanent take.

GROUP III. Case 1. Grafts from all groups and autografts were applied on an amputation stump surface. All took. Grafts of Group I and II decreased in size and disappeared during the fourth week. When discharged at the end of the seventh week two Group IV, one Group III and one autograft remained as permanent takes. (See Group III, Case 1.)

Case 2. Amputation stump surface grafted with skin from a donor of each of the four groups and with autografts, but only one autograft was a permanent take. The grafting was repeated a month later, using all groups, but only Groups III, IV and autografts took. When evacuated one month after the second operation two Group III grafts, one Group IV and two autografts remained as permanent takes.

GROUP IV. Case 1. Shell wound of left thigh. Had two severe secondary hemorrhages and was given 750 c.c. of blood of his own group (Group IV) each time; amputation was done after the second. Forty-six days after injury a thick autograft was removed and applied on the stump, along with similar pieces of skin from donors of each of the four blood groups. In ten days takes from all groups were healthy, large and nearly as thick as the original grafts. From the seventeenth day on to the thirtieth, Groups I, II and III began to shrink and grow steadily thinner and paler. When evacuated on the forty-second day, Groups I, II and III had nearly disappeared while the autografts and isogroup grafts were large, thick and healthy, and in the case of the former were being incorporated with the patient's own ingrowing skin.

Case 2. Extensive burns of the inner aspect of the right thigh from shell explosion. Section grafts from the recipient and from donors of each of the four groups were applied. All of these grafts took and continued to grow equally well for three weeks, when in the course of a few days the members of Groups I, II and III became thin and pale and faded away, leaving only several strong Group IV and autografts behind, which continued to be healthy and increase in size until the twenty-eighth day, when the patient was evacuated. (See Group IV, Case 2.)

Case 3. Amputation stump. Grafts from the four groups and from the patient himself. The original grafts of skin were off and found to be replaced by strong healthy takes two weeks later. About

the twentieth day the Group III primary takes began to resolve and were off a few days later. During the fourth to the seventh week the Group I and II grafts appeared to shrink in size, but at the same time they joined up each with the adjacent skin of the same group. By the seventh week the grafts of Group I had grown very small, while two of Group II came off, leaving the third as a minute pale island. In the meantime three of the Group IV grafts and the auto-graft extending rapidly by peripheral growth joined one another and at the time of evacuation, the beginning of the ninth week, had covered nearly a quarter of the stump surface.

Case 4. Amputation stump. Autografts and grafts from several different donors of each of the four groups were put on the stump surface. Of these one each of Group I, II, III, two isogroup IV and two autografts took. The Group I and II takes disappeared rapidly during the following week, leaving large flourishing Group III and IV grafts. During the last of the seventh week the Group III graft suddenly became pale and disappeared in the course of a few days. When evacuated eight weeks after being grafted only autografts and isografts remained, and these had joined up by peripheral extension and were normal in appearance.

Case 5. Large tangential shell wound of right deltoid. Grafted two weeks after injury. Section autografts and grafts from each of the four groups were used. All were established ten days later. The Group I and II takes had disappeared by the twentieth day and the Group III take during the last of the fourth week, leaving one Group IV graft and two autografts.

Initial takes occurred independently of group compatibility; but *permanent takes* were modified by biological compatibility as follows: Group I patients grew skin from donors of each of the four groups and equally well. Group II grew isogroup grafts and grafts from Group IV, while primary skin takes from Group I and III donors in the course of time either shrunk to minute size or entirely disappeared. Group III recorded only skin from the same group and Group IV as permanent takes. Permanent takes from the same group only were obtained in the case of Group IV recipients.

SUMMARY.

1. Autografts grow best.
2. Isografts obtained from donors of the same blood group as the recipient or from Group IV donors became permanent takes and grew almost if not equally as well as autografts.
3. Isografts where the donor and recipient were of different groups did not remain as permanent growths except when Group IV skin was used or when the recipient was a member of Group I.
4. Group I recipients grew permanent skin from donors of all of the four groups and apparently equally well.
5. Group IV skin grew permanently on recipients of all groups, but only Group IV grafts and autografts remained as permanent takes on Group IV recipients.

6. It appears that skin grafting obeys the principle of blood grouping, as in the transfusion of blood.⁵

I desire to render thanks to Colonel Meek, R. A. M. C., Colonel Pilcher, R. A. M. C., Colonel Crile and Colonel Lower, M. C., U. S., for facilities given for this investigation; to Captain Karsner, Captain Eisenbrey and Lieutenant Richardson, M. C., U. S. A., for doing the laboratory work; and to Sergeant Brownlow, who made the illustrations; also to the entire staff of this Base Hospital, whose coöperation is greatly appreciated.

THE DIFFERENTIAL DIAGNOSIS BETWEEN MITRAL STENOSIS AND AORTIC INSUFFICIENCY.

By EDWARD H. GOODMAN, Major, M. C., U. S. A.,

SPECIAL BOARD FOR CARDIOVASCULAR EXAMINATIONS, CAMP JACKSON, S. C.

The fact that certain cases of mitral stenosis exhibit a diastolic murmur at the base and certain cases of aortic insufficiency exhibit a presystolic murmur at the apex makes the differential diagnosis between the two conditions a matter of some difficulty and of great interest. In pursuing the study of the cases of mitral stenosis and aortic insufficiency seen in the draft examinations, we outlined a routine which we endeavored to follow in each case. This routine included history, location and character of the apex-beat, including thrills, the outline of the cardiac borders with reference to the mid-sternal line, the location and characteristics of the murmurs, blood-pressure studies with arm by the side, arm above the head (patient standing), pressure (recumbent) in the leg and in the arm, vascular signs, including Corrigan pulse, capillary pulse, Traube's sign and Durossiez's sign.

Two questions we have put to ourselves to answer: (1) What is the criterion or what are the criteria which help one in the differential diagnosis? (2) How frequently does it become necessary to distinguish between mitral stenosis with a Graham-Steell murmur and an aortic insufficiency with a Flint murmur?

History, upon which so much importance is laid in civil life, helps us very little with the draft cases. We have found two types of histories: (1) that of severe rheumatic fever in individuals with perfectly normal hearts who do not wish military service and who know how much emphasis is laid on a history of this nature, and (2) that of perfect health throughout their lives given by individuals with

⁵ While completing this report, two suggestions as to the desirability of using matched skin grafts have come to my notice: Davis, J. S.: Some Problems of Plastic Surgery, Annals of Surgery, July, 1917, p. 89. Masson, J. C.: Skin Grafting, Jour. Am. Med. Assn., 1918, lxx, 1581.